

CLAIMS

What is claimed is:

1. An apparatus for preventing free flow through an infusion set, the apparatus comprising:

5 an infusion set formed of flexible tubing, the infusion set having a proximal portion and a distal portion; and

 an occluder disposed in the infusion set between the proximal portion and the distal portion for selectively preventing flow of liquid through the infusion set.

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2. The apparatus of claim 1, wherein the infusion set comprises a resilient tubing, at least a portion of which expands responsive to increases in pressure within the proximal portion of the infusion set.

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3. The apparatus of claim 2, wherein the occluder comprises a sphere.

4. The apparatus of claim 2, wherein the occluder
20 comprises a cylinder.

5. The apparatus of claim 2, wherein the occluder is bullet-shaped.

6. The apparatus of claim 2, wherein the occluder has a cross-section which is ellipsoidal.

5 7. The apparatus of claim 2, wherein the occluder is disk-shaped.

8. The apparatus of claim 2, wherein the occluder is diamond-shaped.

10 9. The apparatus of claim 2, wherein the occluder comprises a stop positioned within the tubing of the infusion set.

15 10. The apparatus of claim 9 wherein the stop has a channel formed therein, the channel having a first end and a second end, and wherein one of the first and second ends is disposed in continuous communication with one of proximal and distal portions of the infusion set and wherein the other of the first and second ends is normally closed by the tubing of
20 the infusion set.

11. The apparatus of claim 10, wherein the tubing of the infusion set expands responsive to increased pressure in the channel and opens the normally closed end of the channel to permit flow of liquid through the channel.

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12. The apparatus of claim 9, wherein the stop has a channel and a wall disposed to normally substantially prevent flow of liquid through the channel, the wall being responsive to increases in pressure to allow liquid flow through the channel when the pressure exceeds a desired threshold.

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13. The apparatus of claim 12, wherein the wall is resilient and returns to a flow prohibiting position when the pressure falls below the predetermined threshold.

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14. The apparatus of claim 12, wherein the wall is scored to remain open after the pressure has dropped below the predetermined threshold.

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15. The apparatus of claim 1, wherein the occluder comprises at least one vane moveable between a first position and a second position responsive to a pressure differential between the proximal portion and the distal portion of the

infusion set.

16. The apparatus of claim 15, wherein the occluder comprises a duck bill valve.

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17. The apparatus of claim 1, further comprising movement preventing means for preventing the occluder from moving distally within the tubing of the infusion set.

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18. The apparatus of claim 15, wherein the movement preventing means comprises projections formed in the tubing of the infusion set.

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19. The apparatus of claim 17, wherein the movement preventing means comprises projections extending from the occluder.

20. The apparatus of claim 17, wherein the movement preventing means comprises a tether.

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21. The apparatus of claim 17, wherein the occluder is tethered to a fitting connecting two portions of the infusion line together.

22. The apparatus of claim 1, wherein the tubing of the infusion set and the occluder form a portion of a compression valve wherein applying pressure to the tubing of the infusion set enables liquid flow past the occluder.

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23. The apparatus of claim 1, further comprising a plurality of engagement surfaces for contacting and compressing the tubing of the infusion set to enable liquid flow past the occluder.

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24. The apparatus of claim 23, wherein the occluder has a shape selected from the group consisting of a spherical, cylindrical, ellipsoidal, bullet-shaped, disk-shaped and diamond-shaped and wherein the engagement surfaces compress portions of the tubing of the infusion set against the occluder to form flow passages between the occluder and portions of the tubing not compressed by the engagement surfaces.

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25. The apparatus of claim 23, wherein the occluder is a valve and wherein the engagement surfaces compress a portion of the tubing of the infusion set to open the valve.

26. The apparatus of claim 1, further comprising a pump housing, the pump housing having at least one channel formed therein for receiving a portion of the infusion set.

5 27. The apparatus of claim 1, further comprising a pump housing having a plurality of engagement surfaces for contacting and compressing the tubing of the infusion set to enable liquid flow past the occluder when a portion of the infusion set containing the occluder is disposed within the
10 channel.

28. The apparatus of claim 1, further comprising a pump housing having a cover attached to the housing for selectively holding the infusion set within the housing.

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29. The apparatus of claim 28, wherein the cover has a projection disposed thereon, the projection being in alignment with the infusion set such that closing the cover causes the projection to engage the infusion set and compress a portion
20 of the infusion set to thereby enable flow of liquid past the occluder.

30. The apparatus of claim 1, further comprising a second occluder disposed in the infusion set for dividing the infusion set into a proximal portion, a middle portion, and a distal portion, the middle portion being disposed between the two occluders.

31. The apparatus of claim 30, further comprising a force actuator disposed in communication with the middle portion for selectively applying a compressive force to the middle portion.

32. An apparatus for selectively preventing free flow through an infusion set, the apparatus comprising:

an infusion set comprising an elongate piece of tubing having a proximal portion and a distal portion, the infusion set being formed from a resilient material which radially expands responsive to pressure within the tubing; and

an occluder positioned within the tubing of the infusion set so as to divide the infusion set into the proximal portion and the distal portion, the occluder being configured to substantially eliminate flow of liquid from the proximal portion of the infusion set to the distal portion while pressure within the proximal portion remains below a

predetermined threshold, while allowing flow of liquid from the proximal portion to the distal portion when pressure in the proximal portion exceeds a predetermined threshold.

5 33. The apparatus of claim 32, wherein the occluder is disposed within the tubing of the infusion set and wherein pressures in the proximal portion of the infusion set which exceed the predetermined threshold cause the tubing of the infusion set to radially expand, thereby allowing fluid flow
10 around the occluder.

 34. The apparatus of claim 33, wherein the occluder comprises a sphere.

15 35. The apparatus of claim 33, wherein the occluder comprises a cylinder.

 36. The apparatus of claim 33, wherein the occluder has a cross-sectional shape which is ellipsoidal.

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 37. The apparatus of claim 33, wherein the occluder is bullet-shaped.

38. The apparatus of claim 33, wherein the occluder is disk-shaped.

39. The apparatus of claim 33, wherein the occluder is
5 diamond-shaped.

40. The apparatus of claim 32, wherein the occluder is disposed within the tubing, the occluder having a channel formed therethrough for enabling fluid flow from the proximal
10 portion to the distal portion and means for preventing flow of liquid through the channel when pressure in the proximal portion is less than the predetermined pressure, while allowing flow of liquid through the channel when pressure in the proximal portion exceeds the predetermined pressure.

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41. The apparatus of claim 40, wherein the means for preventing flow of liquid comprises a wall which closes the channel when pressure within the proximal portion is less than the predetermined pressure.

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42. The apparatus of claim 40, wherein the means for preventing flow of liquid comprises a portion of tubing of the infusion set which prevents flow through the channel and into

the distal portion when pressure in the proximal portion is less than the predetermined pressure.

43. The apparatus of claim 32, further comprising means
5 for preventing distal advancement of the occluder.

44. The apparatus of claim 32, further comprising a plurality of engagement surfaces for compressing portions of the tubing of the infusion set against the occluder to open
10 flow passages between the occluder and other portions of the infusion set.

45. An apparatus for selectively preventing free flow through an infusion set, the apparatus comprising:

15 an infusion set comprising an elongate piece of tubing having a proximal portion and a distal portion; and

an occluder positioned within the tubing of the infusion set so as to divide the infusion set into the proximal portion and the distal portion, the occluder comprising a valve being
20 configured to substantially eliminate flow of fluid from the proximal portion of the infusion set to the distal portion while pressure within the proximal portion remains below a predetermined threshold, while allowing flow of fluid from the

proximal portion to the distal portion when pressure in the proximal portion exceeds a predetermined threshold.

46. The apparatus of claim 45, wherein the occluder
5 comprises a least one vane which prevents flow from the proximal portion to the distal portion when pressure in the proximal portion is less than the predetermined pressure.

47. The apparatus of claim 46, wherein the occluder
10 forms a duckbill valve.

48. An apparatus for selectively preventing free flow through an infusion set, the apparatus comprising:

an infusion set comprising an elongate piece of tubing
15 having a proximal portion and a distal portion, the infusion set being formed from a resilient material which expands responsive to pressure within the tubing;

an occluder positioned within the tubing of the infusion set so as to divide the infusion set into the proximal portion
20 and the distal portion, the occluder being configured to selectively prevent flow of liquid from the proximal portion of the infusion set to the distal portion; and

means for applying force to the infusion set adjacent the

occluder to thereby form a flow channel between the occluder and the infusion set to allow fluid flow past the occluder.

5 49. The apparatus of claim 48, wherein the means for applying a force comprises engagement surfaces.

50. The apparatus of claim 48, wherein the means for applying a force comprises an actuator configured for selectively engaging the infusion set.

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51. A method for preventing free flow through an infusion set, the method comprising:

selecting an infusion set having a proximal portion and a distal portion separated by an occluder disposed therein;

15 filling the proximal portion with a fluid for administration to a patient; and

preventing the fluid from flowing into the distal portion of the infusion set until a predetermined pressure differential exists between the proximal portion and the
20 distal portion.

52. The method according to claim 51, wherein the method comprises selecting an infusion set which will radially expand

when the predetermined pressure differential is exceeded to allow liquid to flow into the distal end of the infusion set.

53. The method according to claim 52, wherein the method
5 comprises selecting an infusion set having a sphere disposed therein to prevent flow when the infusion set is not radially expanded.

54. The method according to claim 52, wherein the method
10 comprises selecting an infusion set having a stop with a channel formed therein disposed within the infusion set, and wherein flow through the channel is regulated by radial expansion of the infusion set.

15 55. The method according to claim 51, wherein the method comprises selecting an infusion set having a duckbill valve disposed therein.

56. The method according to claim 52, wherein the method
20 further comprises placing the infusion set in a device that compresses at least a portion of the infusion set to allow flow to pass from the proximal portion to the distal portion past the occluder.

57. A method for preventing free flow through an infusion set, the method comprising:

selecting an infusion set having an occluder disposed therein so as to divide the infusion set into a proximal portion and a distal portion;

filling the proximal portion with a fluid to be administered to a patient;

preventing the liquid from flowing from the proximal portion to the distal portion until fluid flow into the distal portion is desired; and

opening flow to the distal portion of the infusion set.

58. The method according to claim 57, wherein the method comprises pressurizing the liquid in the proximal portion to at least a predetermined threshold to open flow past the occluder.

59. The method according to claim 58, wherein the method comprises pressurizing the fluid in the proximal portion to radially expand the infusion set and thereby allow flow of fluid past the occluder.

60. The method according to claim 58, wherein the method comprises pressuring the fluid until the fluid opens a valve within the infusion set.

5 61. The method according to claim 57, wherein the method comprises compressing the infusion set to allow flow of fluid past the occluder.

10 62. The method according to claim 57, wherein the method comprises compressing the infusion set to open a valve formed by the occluder and infusion set.

15 63. The method according to claim 57, wherein the method further comprises disposing a portion of the infusion set in a channel formed in a pump housing.

20 64. The method according to claim 64, wherein the method comprises forcefully nesting a portion of the infusion set in the pump housing to opens flow between the occluder and the infusion set.

65. The method according to claim 64, wherein the method further comprises holding the infusion set in the pump housing by closing a cover attached to the pump housing.

5 66. The method according to claim 64, wherein the method further comprises closing a cover attached to the pump housing to compress the infusion set and open flow therethrough.

10 67. The method according to claim 64, wherein the method comprises wrapping a portion of the infusion set around a rotor.

15 68. The method according to claim 67, wherein the method further comprises nesting the occluder and infusion set into the channel to secure engagement between the infusion set and the rotor.

20 69. The method according to claim 57, wherein the method further comprises holding the infusion set in a pump housing by closing a cover attached to the pump housing.

70. The method according to claim 69, wherein the method further comprises closing the cover to compress the infusion set and open flow therethrough.

5 71. A valve for controlling fluid flow, the valve comprising:

an elongate flexible infusion line configured for carrying liquids, the infusion line having a proximal portion, a middle portion, and a distal portion;

10 a first occluder disposed in the infusion set for selectively preventing flow of liquid from the proximal portion to the middle portion;

15 a second occluder disposed in the infusion set for selectively preventing flow of liquid from the middle portion to the distal portion; and

a first actuator associated with the first occluder for selectively applying force to the infusion line to enable fluid flow from the proximal portion to the middle portion past the first occluder.

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72. The valve according to claim 71, further comprising:

a second actuator associated with the second occluder for selectively applying force to the infusion line to enable

fluid flow from the middle portion to the distal portion past the second occluder.

73. The valve according to claim 72, further comprising
5 a drive means for moving the first actuator and the second actuator.

74. The valve according to claim 71, wherein the
infusion line is formed from a resilient material, and wherein
10 application of force by the first actuator against the
infusion line forms a flow channel between the infusion line
and the first occluder.

75. The valve according to claim 72, wherein the
15 infusion line is formed from a resilient material, and wherein
application of force by the second actuator against the
infusion line forms a flow channel between the infusion line
and the second occluder.

20 76. The valve according to claim 71, further comprising
a force actuator disposed adjacent the middle portion for
applying force to the middle portion to force fluid in the
middle portion to flow into the distal portion.

77. A method for controlling fluid flow through an infusion line, the method comprising:

5 selecting an infusion line having a first occluder and a second occluder disposed therein so as to divide the infusion line into a proximal portion, a middle portion and a distal portion, the middle portion being between the first occluder and the second occluder;

10 selectively applying force to the infusion line adjacent the first occluder to enable fluid flow from the proximal portion, past the first occluder and into the middle portion; and

15 selectively applying force to the infusion line adjacent the second occluder to enable fluid flow from the middle portion, past the second occluder and into the distal portion.

78. The method according to claim 77, wherein the method comprises terminating fluid flow from the proximal portion into the middle portion prior to enabling fluid flow from the middle portion into the distal portion.

20 79. The method according to claim 77, wherein the method comprises compressing the middle portion to force fluid to flow from the middle portion into the distal portion.

80. A method for retrofitting a pump for use with a infusion line having an occluder disposed therein, the method comprising:

selecting a pump; and

5 attaching to the pump a clip having a channel formed therein which is configured to receive an infusion line and occluder.

81. The method according to claim 80, wherein the method
10 further comprises sliding an infusion line into the channel such that the channel applies a compressive force to the infusion line to form a flow channel between the infusion line and the occluder.